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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/526,785
Filing Date: March 04, 2005
Appellant(s): WANLASS ET AL.

Mark D. Trenner
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 8/15/2008 appealing from the Office action mailed 3/17/2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US 5,518,934	Forrest et al.	5-1996
US 6,229,152	Dries et al.	5-2001
US 6,350,993	Chu et al.	2-2002

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

- Claims 26 and 30 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 26 recites, "the buffer layer is a compositional overshoot which compensates for residual strain in the buffer layer such that the lattice constant in a growth plain matches that of the relaxed lattice constant of both the intermediate region and the active layer" in lines 1-4. The original disclosure does not provide any support for this claim on page 3 of the specification, as alleged by applicant. There is no discussion in the specification and the drawings fail to provide the support for the language of the instantly claimed limitations. The original specification merely discusses optimum alloy compositions and does not use the term "compositional overshoot". The same arguments apply to claim 30.

- Claims 1-30 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 1 recites, "a lattice constant of the buffer layer parallel to the substrate is matched to a lattice constant of the relaxed intermediate region to discourage glide of threading dislocations from the strained buffer layer to the active layer" in lines 7-9. First, there is no

support for "discourage glide of threading dislocations". The specification does not teaches "glide of threading dislocations" nor does the specification teach discouraging "glide". Second, there is no support for the lattice constant of the buffer layer being matched to the relaxed intermediate region. The specification merely teaches the intermediate region is matched to the active layer, see paragraph [0054] of the published specification. The same arguments apply to claims 2-30 which depend from or contain the same limitation.

- Claim 26 and 30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 26 recites, " a compositional overshoot" in line 2. It is unclear what the composition is supposed to "overshoot". It is unclear what is intended to be "shot" to determine what would "overshoot."

- Claims 1-25 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al (US 5,518,934) in view of Dries et al (US 6,229,152).

Referring to claims 1 and 13, Forrest et al discloses a InP substrate, a compositionally graded step-graded region **21, 23, 25** terminated by a buffer layer **27**; an intermediate region **29, 19**; a $In_{0.7}Ga_{0.3}As$ layer **13** deposited on the buffer layer, this clearly suggests applicant's active layer because Forrest et al teaches the same material as applicant; and a capping layer **Z, 31** (Fig 1B, 5A, 6 and col 3, ln 1-40 and col 7, ln 25-30).

Forrest et al does not teach the intermediate region **29, 19** is relaxed.

In a method of forming a InGaAs detector devices, note entire reference, Dries et al teaches lattice mismatched InGaAs layers, when grown on buffer layers of relaxed InAsP, results in detectors with acceptable dark currents and high bandwidth (col 1, ln 25-65).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Forrest et al by using a relaxed InAsP buffer layer for layers **19,29** for the lattice mismatched InGaAs layer **13** to produce a detector with acceptable dark currents and high bandwidth (col 1, ln 25-65).

Referring to the limitation requiring a strained buffer layer, the combination of Forrest et al and Dries et al teaches a $InAs_{0.4}P_{0.6}$ buffer layer **27** having a thickness of 1 μm (Fig 1B), wherein the layer is expected to be strained because the layer is formed on a mismatched layer **11** (col 3, ln 10-20). This concept of lattice mismatch result in a strained layer is evidenced by Wieczorek et al (US 6,812,074), which teaches a slight lattice mismatch leads to a strain in a layer (col 5, ln 25-35); and applicant also teaches lattice mismatch introduces biaxial strain (see paragraph [0062] of the published application).

Referring to the limitation where a lattice constant of the buffer layer parallel to the substrate is matched to the lattice constant of the relaxed intermediate region, the combination of Forrest et al and Dries et al teaches a graded layer technique has been developed to prevent lattice mismatch dislocations from propagating from layer to layer ('934 col 1, ln 40-60) and matching lattice parameters of layers ('934 col 3, ln 1-20); therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Forrest et al and Dries et al by matching the lattice constant of the buffer layer and the relaxed intermediate region to prevent dislocations. Prevention of dislocation propagation clearly

suggests discouraging glide of dislocations. Furthermore, "to discourage glide of threading dislocations" is merely an effect of lattice matching, and lattice matching would have been obvious, as discussed previously.

Referring to claims 2, 14, 25 and 29, the combination of Forrest et al and Dries et al teaches an InP substrate (col 3, ln 1-10), which is a semi-insulating material.

Referring to claims 3 and 15, the combination of Forrest et al and Dries et al teaches a step graded InAsP buffer layers (col 3, ln 1-15).

Referring to claims 4 and 16, the combination of Forrest et al and Dries et al teaches a `step graded buffer with a InP layer, $InAs_{0.1}P_{0.9}$ layer, $InAs_{0.2}P_{0.8}$ layer, $InAs_{0.3}P_{0.7}$ layer, this clearly suggests applicant's graded region is varied incrementally to accommodate the lattice mismatch between layers **9, 11** and **13** (col 3, ln 1-15).

Referring to claims 5-6 and 17-18, the combination of Forrest et al and Dries et al teaches a $InAs_{0.4}P_{0.6}$ buffer layer **27** having a thickness of 1 μm (Fig 1B), wherein the layer is expected to be strained because the layer is formed on a mismatched layer **11** (col 3, ln 10-20). This concept of lattice mismatch result in a strained layer is evidenced by Wieczorek et al (US 6,812,074), which teaches a slight lattice mismatch leads to a strain in a layer (col 5, ln 25-35); and applicant also teaches lattice mismatch introduces biaxial strain (see paragraph [0062] of the published application).

Referring to claims 7-8 and 19-20, the combination of Forrest et al and Dries et al teaches a graded step-graded region **21, 23, 25** terminated by a buffer layer **27**; an intermediate region **29, 19**; a $In_{0.7}Ga_{0.3}As$ layer **13**, this clearly suggests applicant's active layer because it is the same material claimed by applicant.

Referring to claims 9 and 21, the combination of Forrest et al and Dries et al teaches a capping layer of InAsP **31** (Fig 1B and col 7, ln 20-35).

Referring to claims 10 and 22, the limitation grown for electrical passivation is merely intended use. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. The combination of Forrest et al and Dries et al taches forming a capping layer thus meets the claimed invention.

Referring to claim 11, the combination of Forrest et al and Dries et al teaches an active layer of $In_{0.7}Ga_{0.3}As$ and a step graded region with a buffer using InAsP.

Referring to claims 12 and 23, the combination of Forrest et al and Dries et al teaches vapor phase epitaxy (col 3, ln 1-5).

Referring to claims 24 and 28, the combination of Forrest et al and Dries et al teaches a graded step-graded region **21, 23, 25** terminated by a buffer layer **27**; an intermediate region **29, 19**; a $In_{0.7}Ga_{0.3}As$ layer **13**

Referring to claim 27, the combination of Forrest et al and Dries et al teaches multiple layers between the buffer layers and the active layer **13**, which meets the displacement layer limitation.

- Claims 26 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Forrest et al (US 5,518,934) in view of Dries et al (US 6,229,152) as applied to claims 1-25 and 27-29 above, and further in view of Chu et al (US 6,350,993).

The combination of Forrest et al and Dries et al teaches all of the limitations of claim 26, as discussed previously, except the buffer layer is a compositional overshoot which compensates for residual strain in the buffer layer such that the lattice constant in a growth plain matches that of the relaxed lattice constant of both the intermediate region and the active layer.

In a method of forming relaxed layers, note entire reference, Chu et al teaches an overshoot layer functions to ensure a high degree of relaxation for the surface layer at the interface (col 6, ln 1-20), this clearly suggests the buffer layer is a compositional overshoot which compensates for residual strain in the buffer layer such that the lattice constant in a growth plain matches that of the relaxed lattice constant of both the intermediate region and the active layer.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Forrest et al and Dries et al by using a compositional overshoot layer to ensure a high degree of relaxation, as taught by Chu et al.

(10) Response to Argument

112 first paragraph rejection of claims 26 and 30

Appellant's argument that there is support for a compositional overshoot is noted but is not found persuasive. Appellant alleges that lattice mismatch f is interchangable with composition. However, lattice mismatch is not interchangable with composition. First, bulk misfit f of an epitaxial film is defined by appellant to be $f=a/a_s-1$, where a is the equilibrium film lattice constant and a_s is the substrate lattice constant, See page 2, lines 21-25 of appellant's specification. There is no direct relationship with lattice mismatch f and composition, which can

provide support because lattice mismatch *f* is merely a ratio of two different lattice constants between a film and a substrate. Appellant also alleges that Figure 5 provide support for the "compositional overshoot" limitation, however Figure 5 relates to misfit, not composition.

Appellant's argument that *f* is defined in terms of unstrained lattice constants, where are determined by Vegard's law from composition, is noted but not found persuasive. First, *f* appellant alleges that *f* is determined from **unstrained** lattice constants, however the claimed buffer layer is strained. Second, Vegard's law does not provide support for a "compositional overshoot" because there is no direct relationship with lattice mismatch *f* and composition, which can provide support because lattice mismatch *f* is merely a ratio of two different lattice constants between a film and a substrate.

Appellant's argument that Figure 6 provides support for a "compositional overshoot" is noted but not found persuasive. There is nothing in Figure 6 which relates to composition. Figure 6 merely illustrates crystallographic planes.

112 second paragraph rejection of claims 26 and 30

Appellant's argument that "wherein the buffer layer is compositional overshoot" clearly means that the buffer layer exceeds a target size of the buffer layer compared to standard practice is noted but is not found persuasive. First, compositional overshoot is never used in the original disclosure; therefore there is no support in the original disclosure for this proposed definition of compositional overshoot. Second, standard practice is only used in the background of the invention section of Appellant's disclosure and is not used to describe Appellant's invention in the description of Appellant's invention. Appellant never defines the buffer layer is a compositional overshoot of the standard practice of the prior art. Finally, the claim does not

recites a compositional overshoot of an alloy composition of a standard practice; therefore Appellant's arguments are directed to limitations which are not claimed.

112 first paragraph rejection of independent claims 1 and 13

Appellant's argument that "discourage glide dislocations" is supported on pages 1, 3, 4 and 12 of the specification is noted but is not found persuasive. Page 1 recites, "to prevent threading dislocations from reaching the active region." Page 3 recites, "to displace the active layer from the graded region, reducing the influence of underlying dislocations on the active layer." Page 4 recites, "to spatially separate the active layer from the misfit dislocation networks that reside in the graded region, and to limit the propagation of threading dislocations into the active region." None of the cited portions provide support for to discourage **glide** of threading dislocations. As to the layer being unstrained thus providing support for the limitation, there is no support in the original disclosure for preventing dislocation glide.

Appellant's argument that the "lattice constant of the buffer layer is matched to the relaxed intermediate region" is supported by the specification is noted but not found persuasive. Appellant alleges support on page 5 and page 12. Page 5 recites, "a strained buffer layer provides a lattice matched template for the coherent growth of an unstrained **active** layer." **(emphasis added).** Page 12 recites, "the intermediate region contains a displacement layer that is lattice matched to the **active** layer." **(emphasis added).** Neither page 5 nor page 12 teach that the lattice constant of the buffer layer parallel to the substrate is matched to the lattice constant of the relaxed intermediate region. There is only support for matching the buffer layer to the active layer, not the intermediate region (See page 4, lines 16-18 which teaches the buffer layer is in a state of biaxial strain that causes the in-plane lattice constant of the buffer layer to match

precisely the unstrained lattice constant of the **active** layer (**emphasis added)**. As to the Figure 5 providing support, Figure 5 is directed to misfits, not to lattice constants; therefore figure 5 does not provide support for the in plane lattice constant being matched to a lattice constant of the relaxed intermediate region.

35 U.S.C. §103(a) rejection of independent claim 1

The issue is whether it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Forrest by forming relaxed intermediate region when Dries teaches relaxed buffer layers are known to be used in forming devices, and Appellant admits the it is known to one of ordinary skill in the art that strain drives dislocation glide (see the last paragraph on page 6 of the brief which continues onto the top of page 7). It is the examiner's position that Forrest does not teach that the region between the active layer and the buffer layer is relaxed, however it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Forrest by using Dries's teaching that lattice mismatched

Appellant alleges that the Examiner admits there is no disclosure that layer 27 of Forrest is a relaxed intermediate region. This is not the basis of the rejection. The Examiner relies on layer 27 to teach the buffer layer and layers 29, 19 to teach an intermediate region, which the examiner relies upon Dries to suggest to one of ordinary skill in the art to teach a relaxed layer.

Appellant alleges that Dries teaches mismatched transition layers in the abstract and lattice matched transition layers in column 2. These arguments are not persuasive because the basis of the rejection is found in the background section Dries, column 1, which teaches lattice mismatched InGaAs, when grown on buffer layers of relaxed InAsP, results in detectors with acceptable dark current and high bandwidths (column 1, lines 55-60). Appellant does not address

the teachings of Dries which are relied upon by the Examiner, which are found in column 1, and which clearly teach the desirability of relaxed buffer layers.

The combination of Forrest et al and Dries et al would have been obvious to one of ordinary skill in the art for several reasons. First, Forrest et al teaches to accommodate the lattice mismatch between adsorption layers **9, 11** and **13**, a step graded region of 1 μm thick buffer layers **21, 23, 25, 17, 27, 29**, and **19** are grown, and the lattice parameters of the InGaAs adsorption layers matches the lattice parameter of the InAsP buffer layers immediately underneath (column 3, lines 8-15). Forrest et al also teaches the buffer layers are formed for preventing lattice mismatch dislocations from propagating (abstract). Forrest et al teaches lattice matching the buffer layer and the buffer layer is designed to prevent propagation of dislocation defects. Dries et al teaches the same materials, InGaAs and InAsP buffer layers, and relaxed buffer layers result in detectors of acceptable dark currents (column 1, lines 55-60). Therefore, It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Forrest's buffer layer by forming relaxed buffers, as taught by Dries et al, to produce detectors with acceptable dark currents, which is a desirable property to Forrest (see column 3, lines 15-20, which teaches lattice mismatch results in high dark currents).

Second, Appellant's admit that a person of ordinary skill in the art knows that strain drives dislocation glide, and an unstrained layer will discourage threading dislocation glide (See the last paragraph on page 6 which continues to the top of page 7 of the Appeal brief filed 8/15/2007). The only modification made to Forrest in view of Dries is that the layer is relaxed (unstrained) and Appellant has admitted that unstrained layers are known to one of ordinary skill

in the art and would discourage dislocation glide; therefore it is unclear how Appellant can allege that the feature would be unobvious.

35 U.S.C. §103(a) rejection of claim 13

Appellant's remarks are based on the remarks to claim 1. The Examiner's response to claim 1 is discussed above.

35 U.S.C. §103(a) rejection of claims 2-12, 14-25 and 27-29

Appellant's remarks are based on the remarks to claim 1. The Examiner's response to claim 1 is discussed above.

35 U.S.C. §103(a) rejection of claims 26 and 30

Appellant's argument that Forrest states that layer **27** does not exactly match that of the adsorption layer is noted but is not persuasive. The Examiner admits Forrest teaches the layer **27** does not exactly match that of the adsorption layer. However, Forrest does teach that the lattice parameters of the layers should match and the mismatch may be the source of somewhat elevated dark currents (column 3, lines 12-17). Forrest et al also teaches the preferred device is one where the lattice parameters of layers 27 and 11 match. (column 3, lines 19-20). Therefore, Forrest et al clearly suggests matching lattice parameters.

Appellant also alleges that Chu discloses a space layer to separate differently doped layers is noted but is not found persuasive. Appellant's argument is not persuasive because the argument does not address the portion of the Chu relied upon by the Examiner. Chu et al teaches an overshoot layer function to ensure a high degree of relaxation (column 96, lines 10-15); therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the prior art by using Chu et al's overshoot layer to ensure a high degree of

relaxation. It is unclear how a spacer layer to separate differently doped layers has any relevance to rebut Chu's teaching of an overshoot layer to ensure relaxation.

Appellant's argument the Chu is silent as to discourage glide is noted but is not found persuasive. Chu is not relied upon to teach this feature. The combination of Forrest et al and Dries et al clearly suggest this limitation. The combination of Forrest et al and Dries et al teaches a graded layer technique has been developed to prevent lattice mismatch dislocations from propagating from layer to layer ('934 col 1, ln 40-60) and matching lattice parameters of layers ('934 col 3, ln 1-20); therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Forrest et al and Dries et al by matching the lattice constant of the buffer layer and the relaxed intermediate region to prevent propagation of dislocations. Prevention of dislocation propagation clearly suggests discouraging glide of dislocations. Furthermore, "to discourage glide of threading dislocations" is merely an effect of lattice matching and merely recites the purpose of lattice matching, and lattice matching would have been obvious, as discussed previously; therefore the effect would be expected.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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